DEVELOP National Program
Langley Research Center

Gulf of Mexico Air Quality: CALIPSO Decision Support for Gulf of Mexico Air Quality Relating to the Deepwater Horizon Oil Spill

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Project Overview

On April 20, 2010, an oil platform belonging to BP exploded and leaked a huge volume of oil into the Gulf of Mexico. In an effort to control the spread of the oil, BP applied dispersants such as Corexit and conducted in-situ burnings of the oil. This catastrophe created a complex chain of events that affected not only the fragile water and land ecosystems, but the humans who breathe the air every day. Thousands of people were exposed to fumes associated with oil vapors from the spill, burning of the oil, and the toxic mixture of dispersants.

While aiding in clean-up efforts, local fishermen were directly exposure to fumes when working on the Gulf. A notable amount of Gulf Coast residents were also exposed to the oil fumes as seasonal southeasterly winds blew vapors toward land. The Volatile Organic Compounds (VOC) found in oil vapors include: benzene, toluene, ethyl benzene, xylene, naphthalene, hydrogen sulfide and particulate matter (PM). Increases in water temperature and sunlight due to the summer season allow for these VOCs and PM to evaporate into the air more rapidly. Aside from the VOCs found in oil vapors, the dispersant being used to break up the oil is highly toxic and is thought to be even more toxic than the oil itself (EPA website, 2010).

To protect human health, the environment, and to make informed policy decisions relevant to the spill, the EPA Region 6 has continuously monitored the affected areas carefully for levels of pollutants in the outdoor air that are associated with petroleum products and the burning of oil along the coast. In an effort to prevent, prepare for, and respond to future oil spills that occur in and around inland waters of the United States, the EPA has been working with local, state, and federal response partners.

Air quality measurements were collected by the EPA at five active monitoring systems stationed along the coast. There are fixed monitors in Alabama, Louisiana, Mississippi, and Florida. However, the EPA does not have any fixed monitoring stations over the water, which makes it extremely difficult to collect data regarding the amount and intensity of aerosols over the sea. To assist the EPA Region 6 air quality monitoring efforts, the DEVELOP team investigated the use of the CALIPSO lidar (CALIOP) level 2 version 3.01 nighttime aerosol products and the HYSPLIT model to monitor aerosols and dispersants over the ocean resulting from the Horizon Oil Spill. CALIOP is a two-wavelength polarization-sensitive lidar that provides high-resolution vertical profiles of aerosols and clouds. Since CALIOP has a 5km horizontal resolution and a 16 day orbit, aerosol information from the affected oil spill area can be measured over the ocean. Approximately 2-5 images from CALIOP can be taken of the oil spill area. From analysis of various CALIOP aerosol profiles and extinction coefficients, comparisons between the time periods before and after the occurrence of the oil spill were conducted. Once dates of significant aerosol activities were recorded and researched for attributable factors, correlations were made with the air quality data offered on the EPA website. The CALIOP aerosol profile and extinction coefficients obtained will serve to supplement EPA monitoring and be a tool to help EPA understand the aerosol activity over the ocean.

The HYSPLIT model from NOAA was also used to supplement EPA air quality monitoring in the Gulf of Mexico. HSYPLIT forward trajectories allow the path of the oil spill smoke plume to be tracked and utilized for mitigation purposes. This gives the EPA significantly improved monitoring abilities, and would allow smoke plume projections that continue too far inland to be accounted for with early evacuation processes or air quality warnings for coastal

residences. The forward trajectories created by the HYSPLIT model also serve as a basis for the project collaborator, the Mobile County Health Department DEVELOP team, to pull public health data for correlation analysis.

At the conclusion of the project, EPA Region 6 will be given a methodology describing the use of various NASA EOS products together to monitor air quality measurements in relation to the Deepwater Horizon oil spill. CALIPSO Level 2 Version 3.01 Aerosol Extinction data, MODIS, and the HYSPLIT model will be among the NASA EOS data and products utilized. The methodology will serve to supplement sparse monitoring stations and to further the EPA's understanding of air quality levels at sea.

Utilizing the air quality issues relating to the BP Horizon Oil Spill as a case study, this project can provide methodologies for future oil spill air quality monitoring in the case of another disastrous event. Other future work in this area would also address the water quality issues arising from the spill and the impacts on the coastal habitats as long-term impacts of the oil spill on the water quality of the Gulf of Mexico remains to be seen.

Project Mentors:
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Image 1: CALIPSO's CALIOP sensor views the Deepwater Horizon oil spill on May 2, 2010. The low-lying red layer indicates the location of the aerosols over the spill. - Source: Atmospheric Science Data Center

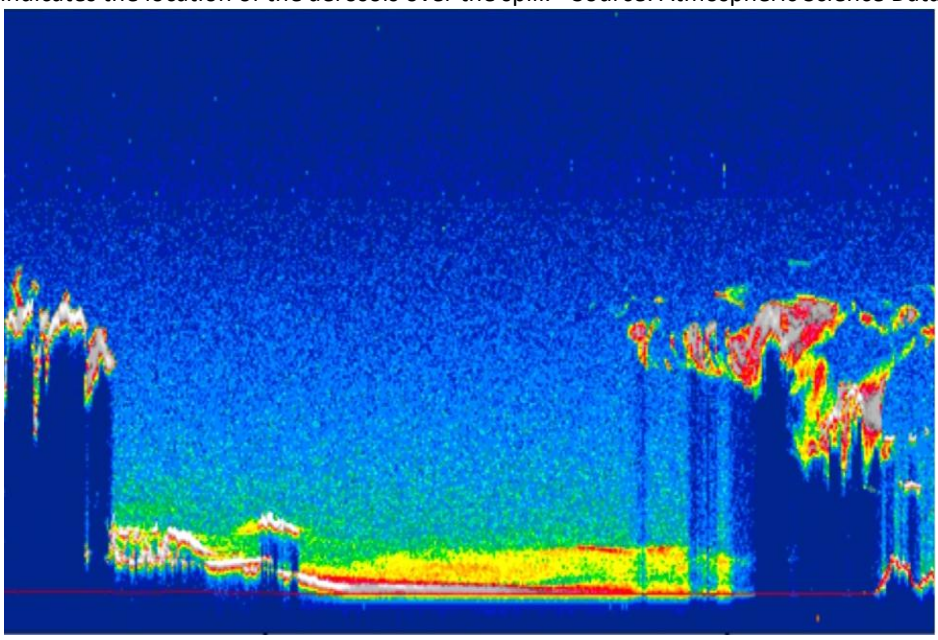

Image 2: MODIS sunglint imagery from May 24, 2010 with inlaid study area map for geographic reference. The oil is clearly seen as the shiny light-colored mass in the center.